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# AMBIENT NOISE AND SEA ICE BEHAVIOR

## FINAL REPORT

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## OBJECTIVES

This is a study of sea ice behavior, including generation of under-ice noise. The objectives were to:

- (1) measure ambient noise levels during the CEAREX Drift Experiment, analyze and archive the data;
- (2) gain understanding of processes that cause ice to emit noise, and model under-ice noise generated by different physical processes, especially by shearing of the oceanic mixed layer, micro-cracking, pressure and shear ridging;
- (3) integrate ice mechanics research with fundamental investigations in solid mechanics, materials, ocean engineering, and acoustics to improve understanding of ice stress and its relationship fracture dynamics to ambient noise and low frequency acoustic interaction;
- (4) understand the mechanical energy balance of the ice cover and the energy exchange through the atmosphere-ice-ocean system;
- (5) understand mathematical characteristics of ice dynamics models and their relationships to observed lead patterns; and
- (6) examine the large scale failure processes that control lead formation and the capability of plasticity models to simulate these processes.

Results of the study were presented in the articles described in the following list of publications.

Ambient noise data measured during the CEAREX Drift Experiment are reported on the CD-ROM titled, "Eastern Arctic Ice, Ocean and Atmosphere Volume 1" and available from the National Snow and Ice Data Center, CIRES, University of Colorado, Boulder.

## PUBLICATIONS

- a) papers published in refereed journals  
CEAREX Drift Group, "The CEAREX Drift Experiment," *EOS Transactions*, Am. Geophys. Union, Vol. 71, No. 40, October 2, 1990.  
Pritchard, R. S., "Sea Ice Noise-Generating Processes," *J. Acoust. Soc. Am.*, Vol. 88, No. 6, 2830-2842, 1990.

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Pritchard, R. S. "Sea Ice Mechanical Energy Balance: Nearshore Chukchi Sea 1982," in *Annals of Glaciol.*, vol. 15, Int'l. Glaciol. Soc., Cambridge, pp. 63-72, 1991.

b) papers submitted to refereed journals

Pritchard, R. S., Bourke, R. H., and Cousins, J. D., "Eastern Arctic Ambient Noise: October-November 1988," submitted to *J. Acoust. Soc. Am.*, November 1991.

c) books or chapters published

Hipsey, S. J. "Ambient Noise due to the Shearing of the Boundary Layer under Sea Ice," Naval Postgraduate School thesis, Monterey, CA, December 1988.

Cousins, J. D. "CEAREX Ambient Noise Data Measured Northeast of Svalbard," Naval Postgraduate School thesis, Monterey, CA, March 1991.

d) books or chapters submitted

Pritchard, R. S., "Sea Ice Constitutive Behavior and Under-Ice Noise," to appear in *Natural Physical Sources of Underwater Sound*, (ed) B. Kerman, Kluwer Academic Press, The Netherlands.

Pritchard, R. S., "Large-Scale Lead Patterns in Sea Ice," to appear in *Proceedings of the First Soviet-American Workshop on Ice Mechanics and its Applications*, 16-26 June 1991, Institute for Problems in Mechanics, Moscow.

e) papers (not refereed)

Pritchard, R. S., "Eastern Arctic Ambient Noise," in *Oceans'89*, vol.4, IEEE Pub. No.89CH2780-5, New York, 1246-1251, 1989.

Pritchard, R. S. (192) Discussion of "On Modeling the Energetics of the Ridging Process by M. A. Hopkins and W. D. Hibler III," *J. Offshore Mech. and Arctic Engr.*, vol.114, n. 1, pp. 66-67.

Pritchard, R. S., "Sea Ice Leads and Characteristics," to appear in *Proceedings of LAHR Ice Symposium 1992*, 15-19 June, 1992, Banff, Alberta.

### INVITED PRESENTATIONS

Pritchard, R. S., "Sea Ice Constitutive Behavior and Under-Ice Noise," Invited presentation to NATO Workshop on Natural Physical Sources of Underwater Sound, Downing College, University of Cambridge, Cambridge, England, 3-6 July 1990.

Pritchard, R. S., "Modeling Ambient Noise: CEAREX Drift Experiment," Invited Presentation to AEAS Arctic Data Analysis Workshop, University of Washington, Seattle, WA, 21-22 August, 1990.

Pritchard, R. S., "Modeling Under-ice Ambient Noise," Invited presentation to NOARL as part of Distinguished Lecture Series, Stennis Space Center, MS, 29 November 1990.

Pritchard, R. S., "Large-Scale Lead Patterns in Sea Ice," Invited lecture at First Soviet-American Workshop on Ice Mechanics and Its Applications, Institute for Problems in Mechanics, Soviet Academy of Sciences, 16-26 June 1991, Moscow, U.S.S.R.

Statement A per telecon Dr. Thomas Curtin  
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